EXHIBIT E

CURRICULUM VITAE

OREN ETZIONI

Professor Emeritus
Paul G. Allen School of Computer Science & Engineering
University of Washington
Seattle, WA 98195
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Born January 19, 1964. New York, N.Y., U.S. citizen.

Employment History

Founder, TrueMedia.org January 2024 --

Founding CEO, Allen Institute for Artificial Intelligence,
January 2014 – September 2022

Professor Emeritus, Paul G. Allen School of Computer Science & Engineering
University of Washington. October 2020 --

Professor, Department of Computer Science and Engineering,
University of Washington. September 2005 – October 2020

Associate Professor, Department of Computer Science and Engineering,
University of Washington. September 1996 – September 2005.

Chief Technology Officer, Go2net, Inc. April 1999 – April 2000.

Assistant Professor, Department of Computer Science and Engineering,
University of Washington. February 1991 – September 1996.

Educational

Carnegie Mellon University, School of Computer Science, Pittsburgh, PA.
Ph.D. January 1991; M.S., Computer Science, August 1988.
Thesis title: *A Structural Theory of Explanation-Based Learning.*
Thesis advisor: Tom Mitchell.

Harvard University, Cambridge, MA.
Honors B.A. in Computer Science, June 1986.

Honors and Awards

ACL 2022 10 Year Test of Time Award for **"**Open Language Learning for Information Extraction." (EMNLP 2012)

IUI 2022 Most Impact Paper Award for "Towards a theory of natural language interfaces to databases." (IUI 2003)

Geekwire's "Geek of the Year" 2013

Washington Research Foundation Endowed Entrepreneurship Professorship in Computer Science and Engineering 2009

Robert S. Engelmore Memorial Lecture Award 2007

Distinguished Paper Award at IJCAI '05 for *A Probabilistic Model of Redundancy in Information Extraction*

AAAI Fellow 2003

Best Paper Runner up in WWW '04 for *Semantic Email*

Best Paper Runner up in WWW '97 for *Dynamic Reference Sifting: A Case Study in the Homepage Domain*

MetaCrawler selected as *Best Web Search Solution* in Infoworld (May 1997)

Internet Softbot chosen as one of 5 finalists in the 1995 National *DISCOVER Awards for Technological Innovation in Computer Software*

NSF Young Investigator Award 1993

NSF Research Initiation Award 1992

AT&T Bell Laboratories Fellow 1987–1990

NSF graduate fellowship 1987 (declined)

Harvard College Scholarship for Academic Excellence 1984–1986

Member of Harvard's programming team. Second place in ACM's northeast region meet 1986

Rigorously Referred Publications (see Google Scholar for more UpToDate list)

[1] Amitai Etzioni, Oren Etzioni. "Incorporating Ethics into Artificial Intelligence." *The Journal of Ethics* ISSN 1382-4554, 07 March 2017.

[2] Luca Weihs and Oren Etzioni. "Learning to Predict Citation-Based Impact Measures." *2017 ACM/IEEE Joint Conference on Digital Libraries (JCDL)* (2017): 1-10.

[3] Oren Etzioni. "Artificial intelligence: AI zooms in on highly influential citations." *Nature* 547 7661 (2017): 32.

[4] Peter Clark, Oren Etzioni, Tushar Khot, Ashish Sabharwal, Oyvind Tafjord, Peter D. Turney and Daniel Khashabi. "Combining Retrieval, Statistics, and Inference to Answer Elementary Science Questions." *AAAI* (2016).

[5] Daniel Khashabi, Tushar Khot, Ashish Sabharwal, Peter Clark, Oren Etzioni and Dan Roth. "Question Answering via Integer Programming over Semi-Structured Knowledge." *IJCAI* (2016).

[6] Amitai Etzioni and Oren Etzioni. "AI assisted ethics." *Ethics and Information Technology* 18 (2016): 149-156.

[7] Bhavana Dalvi, Sumithra Bhakthavatsalam, Chris Clark, Peter Clark, Oren Etzioni, Anthony Fader and Dirk Groeneveld. "IKE - An Interactive Tool for Knowledge Extraction." *AKBC@NAACL-HLT* (2016).

[8]   Shih-Wen Huang, Jonathan Bragg, Isaac Cowhey, Oren Etzioni and Daniel S. Weld. "Toward Automatic Bootstrapping of Online Communities Using Decision-theoretic Optimization." *CSCW* (2016).

[9]   Marco Valenzuela, Vu Ha and Oren Etzioni. "Identifying Meaningful Citations." *AAAI Workshop: Scholarly Big Data* (2015).

[10] Rik Koncel-Kedziorski, Hannaneh Hajishirzi, Ashish Sabharwal, Oren Etzioni and Siena Dumas Ang. "Parsing Algebraic Word Problems into Equations." *TACL* 3 (2015): 585-597.

[11] Tushar Khot, Niranjan Balasubramanian, Eric Gribkoff, Ashish Sabharwal, Peter Clark and Oren Etzioni. "Exploring Markov Logic Networks for Question Answering." *EMNLP* (2015).

[12] Serge Abiteboul, Xin Dong, Oren Etzioni, Divesh Srivastava, Gerhard Weikum, Julia Stoyanovich and Fabian M. Suchanek. "The elephant in the room: getting value from Big Data." *WebDB* (2015).

[13] Min Joon Seo, Hannaneh Hajishirzi, Ali Farhadi, Oren Etzioni and Clint Malcolm. "Solving Geometry Problems: Combining Text and Diagram Interpretation." *EMNLP* (2015).

[14] Mohammad Javad Hosseini, Hannaneh Hajishirzi, Oren Etzioni, and Nate Kushman: Learning to Solve Arithmetic Word Problems with Verb Categorization; In EMNLP 2014.

[15] Foster Provost, Geoffrey I. Webb, Ron Bekkerman, Oren Etzioni, Usama Fayyad, and Claudia Perlich: A Data Scientist's Guide to Start-Ups; In Big Data, vol. 2, no. 3 (Sept. 2014).

[16] Anthony Fader, Luke Zettlemoyer, Oren Etzioni: Open Question Answering Over Curated and Extracted Knowledge Bases; In KDD 2014

[17] Oren Etzioni: The battle for the future of data mining; SIGKDD 2014

[18] YH Tseng, LH Lee, SY Lin, BS Liao, MJ Liu, HH Chen, Oren Etzioni and Anthony Fader: Chinese Open Relation Extraction for Knowledge Acquisition; EACL 2014

[19] Min Joon Seo, Hannaneh Hajishirzi, Ali Farhadi and Oren Etzioni: Diagram Understanding in Geometry Questions; 2014

[20] Oren Etzioni: To buy or not to buy: that is the question; SIGKDD 2013

[21] Niranjan Balasubramanian, Stephen Soderland, Mausam and Oren Etzioni: Generating Coherent Event Schemas at Scale; EMNLP 2013

[22] Alan Ritter, Luke Zettlemoyer, Mausam and Oren Etzioni: Modeling Missing Data in Distant Supervision for Information Extraction; TACL 2013

[23] Anthony Fader, Luke Zettlemoyer and Oren Etzioni: Paraphrase-Driven Learning for Large Scale Question Answering; *ACL 2013*.

[24] Janara Christensen, Mausam, Stephen Soderland, and Oren Etzioni: Towards Coherent Multi-Document Summarization; *NAACL 2013*.

[25] Mausam, Michael Schmitz, Stephen Soderland, Robert Bart, Oren Etzioni: Open Language Learning for Information Extraction. *EMNLP-CoNLL 2012:* 523-534

[26] Thomas Lin, Mausam, Oren Etzioni: No Noun Phrase Left Behind: Detecting and Typing Unlinkable Entities. *EMNLP-CoNLL 2012*: 893-903

[27] Alan Ritter, Mausam, Oren Etzioni, Sam Clark: Open domain event extraction from twitter. *KDD 2012*: 1104-1112

[28] Jeff Huang, Oren Etzioni, Luke S. Zettlemoyer, Kevin Clark, Christian Lee: RevMiner: an extractive interface for navigating reviews on a smartphone. *UIST 2012*: 3-12

[29]   Alan Ritter, Sam Clark, Mausam, Oren Etzioni: Named Entity Recognition in Tweets: An Experimental Study. *EMNLP 2011*: 1524-1534

[30]   Anthony Fader, Stephen Soderland, Oren Etzioni: Identifying Relations for Open Information Extraction. *EMNLP 2011*: 1535-1545

[31]   Oren Etzioni, Anthony Fader, Janara Christensen, Stephen Soderland, Mausam: Open Information Extraction: The Second Generation. *IJCAI 2011*: 3-10

[32]   Janara Christensen, Mausam, Stephen Soderland, Oren Etzioni: An analysis of open information extraction based on semantic role labeling. *K-CAP 2011:* 113-120

[33]   Stefan Schoenmackers, Jesse Davis, Oren Etzioni, and Daniel S. Weld, "Learning First-Order Horn Clauses from Web Text," in *Proceedings of the 2010 Conference on Empirical Methods in Natural Language Processing*, Cambridge, MA, 2010

[34]   Thomas Lin, Mausam, and Oren Etzioni, "Identifying Functional Relations in Web Text," in *Proceedings of the 2010 Conference on Empirical Methods in Natural Language Processing*, Cambridge, MA, 2010

[35]   Doug Downey, Oren Etzioni, and Stephen Soderland, "Analysis of a Probabilistic Model of Redundancy in Unsupervised Information Extraction," *Artificial Intelligence*, 174(11):726-748, 2010.

[36]   Mausam, Stephen Soderland, Oren Etzioni, Daniel S. Weld, Kobi Reiter, Michael Skinner, Marcus Sammer, and Jeff A Bilmes, "Panlingual Lexical Translation via Probabilistic Inference," *Artificial Intelligence*, 174(9-10):619-637, 2010.

[37]   Alan Ritter, Mausam, and Oren Etzioni, "A Latent Dirichlet Allocation method for Selectional Preferences," in *Proceedings of the 48th Annual Meeting of the Association for Computational Linguistics* (pp.424-434), Uppsala, Sweden, 2010.

[38]   Anthony Fader, Stephen Soderland, and Oren Etzioni, "Extracting Sequences from the Web," in *Proceedings of the 48th Annual Meeting of the Association for Computational Linguistics* (pp.286-290), Uppsala, Sweden, 2010.

[39]   Mausam, Stephen Soderland, and Oren Etzioni, "Panlingual Lexical Translation via Probabilistic Inference," in *Proceedings of the 24th AAAI Conference on Artificial Intelligence*, Atlanta, GA, 2010.

[40]   Thomas Lin, Oren Etzioni and James Fogarty, "Identifying Interesting Assertions from the Web," in *Proceeding of the 18th ACM conference on Information and knowledge management*, Hong Kong, China, 2010.

[41]   Stephen Soderland, Christopher Lim, Mausam, Bo Qin, Oren Etzioni, and Jonathan Pool, "Lemmatic Machine Translation," in *Proceedings of the 12th Machine Translation Summit* (pp.128-135), Ottawa, Canada, 2009.

[42]   Mausam, Stephen Soderland, Oren Etzioni, Daniel S. Weld, Michael Skinner, and Jeff Bilmes, "Compiling a Massive, Multilingual Dictionary via Probabilistic Inference," in *Proceedings of the Joint Conference of the 47th Annual Meeting of the ACL and the 4th International Joint Conference on Natural Language Processing of the AFNLP* (pp.262-270), Suntec, Singapore, 2009.

[43]   Janara Christensen, Mausam, and Oren Etzioni, "A Rose is a Roos is a Ruusu: Querying Translations for Web Image Search," in *Proceedings of the ACL-IJCNLP 2009 Conference Short Papers* (pp.193-196), Suntec, Singapore, 2009.

[44]   Doug Downey and Oren Etzioni, "Look Ma, No Hands: Analyzing the Monotonic Feature Abstraction for Text Classification," in *Proceedings of the 22nd Annual Conference on Neural Information Processing Systems* (pp.393-400), Vancouver, Canada, 2008.

[45]   Stefan Schoenmackers, Oren Etzioni, and Daniel S. Weld, "Scaling Textual Inference to the Web," in *Proceedings of the 2008 Conference on Empirical Methods in Natural Language Processing* (pp. 79-88), Honolulu, HI, 2008

[46]   Alan Ritter, Doug Downey, Stephen Soderland, and Oren Etzioni, "It's a Contradiction -- No, It's Not: A Case Study using Functional Relations," in *Proceedings of the 2008 Conference on Empirical Methods in Natural Language Processing* (pp. 11-20), Honolulu, HI, 2008

[47]   Michele Banko and Oren Etzioni, "The Tradeoffs Between Open and Traditional Relation Extraction," in *Proceedings of the 46th Annual Meeting of the Association for Computational Linguistics* (pp. 28-36), Columbus, OH, 2008.

[48]   Michele Banko and Oren Etzioni, "Strategies for Lifelong Knowledge Extraction from the Web," in *Proceedings of the 4th International Conference on Knowledge Capture* (pp. 95-102), Whistler, Canada, 2007.

[49]   Oren Etzioni, Kobi Reiter, Stephen Soderland, and Marcus Sammer, "Lexical Translation with Application to Image Search on the Web," in *Proceedings of the 11th Machine Translation Summit* (pp. 175-182), Copenhagen, Denmark, 2007.

[50]   Michael J. Cafarella, Dan Suciu, and Oren Etzioni, "Navigating Extracted Data with Schema Discovery," in *Proceedings of the 10th International Workshop on the Web and Databases*, Beijing, China, 2007.

[51]   Doug Downey, Stefan Schoenmackers, and Oren Etzioni, "Sparse Information Extraction: Unsupervised Language Models to the Rescue," in *Proceedings of the 45th Annual Meeting of the Association for Computational Linguistics* (pp. 696-703), Prague, Czech Republic, 2007.

[52]   Alexander Yates and Oren Etzioni, "Unsupervised Resolution of Objects and Relations on the Web," in *Proceedings of Human Language Technologies: Annual Conference of the North American Chapter of the Association for Computational Linguistics* (pp. 121-130), Rochester, NY, 2007.

[53]   Michele Banko, Michael J. Cafarella, Stephen Soderland, Matt Broadhead, and Oren Etzioni, "Open Information Extraction from the Web," in *Proceedings of the 20th International Joint Conference on Artificial Intelligence* (pp. 2670-2676), Hyderabad, India, 2007.

[54]   Doug Downey, Matthew Broadhead, and Oren Etzioni, "Locating Complex Named Entities in Web Text," in *Proceedings of the 20th International Joint Conference on Artificial Intelligence* (pp. 2733-2739), Hyderabad, India, 2007.

[55]   Michael J. Cafarella, Christopher Re, Dan Suciu, Oren Etzioni, and Michele Banko, "Structured Querying of Web Text: A Technical Challenge," in *Proceedings of the 3rd Biennial Conference on Innovative Data Systems Research* (pp. 225-234), Asilomar, CA, 2007.

[56]   Michael J. Cafarella, Oren Etzioni, and Dan Suciu, "Structured Queries Over Web Text," *IEEE Data Bulletin*, 29(4):45-51, 2006.

[57]   Oren Etzioni, Michele Banko, and Michael J. Cafarella, "Machine Reading," in *Proceedings of the 21st National Conference on Artificial Intelligence*, Boston, MA, 2006.

[58]   Marcus Sammer, Kobi Reiter, Stephen Soderland, Katrin Kirchhoff, and Oren Etzioni, "Ambiguity Reduction for Machine Translation: Human-Computer Collaboration," in *Proceedings of the 7th*

Conference of the Association for Machine Translation in the Americas (pp. 193-202), Cambridge, MA, 2006.

[59]   Alexander Yates, Stefan Schoenmackers, and Oren Etzioni, "Detecting Parser Errors Using Web-based Semantic Filters," in *Proceedings of the Conference on Empirical Methods in Natural Language Processing* (pp. 27-34), Sydney, Australia, 2006.

[60]   Ana-Maria Popescu and Oren Etzioni, "Extracting Product Features and Opinions from Reviews," in *Proceedings of the Conference on Empirical Methods in Natural Language Processing* (pp. 339-346), Vancouver, Canada, 2005.

[61]   Michael J. Cafarella, Doug Downey, Stephen Soderland, and Oren Etzioni, "KnowItNow: Fast, Scalable Information Extraction from the Web," in *Proceedings of the Conference on Empirical Methods in Natural Language Processing* (pp. 563-570), Vancouver, Canada, 2005.

[62]   Doug Downey, Oren Etzioni, and Stephen Soderland, "A Probabilistic Model of Redundancy in Information Extraction," in *Proceedings of the 19th International Joint Conference on Artificial Intelligence* (pp. 1034-1041), Edinburgh, Scotland, 2005.

[63]   Michael J. Cafarella and Oren Etzioni, "A Search Engine for Natural Language Applications," in *Proceedings of the 14th International World Wide Web Conference* (pp. 442-452), Chiba, Japan, 2005.

[64]   Oren Etzioni, Michael Cafarella, Doug Downey, Ana-Maria Popescu, Tal Shaked, Stephen Soderland, Daniel S. Weld, and Alexander Yates, "Unsupervised named-entity extraction from the Web: An experimental study," *Artificial Intelligence*, 165(1):91-134, 2005.

[65]   Luke McDowell, Oren Etzioni, and Alon Halevy, "Semantic email: Theory and applications," *Journal of Web Semantics*, (pp. 244-254), 2004.

[66]   Ana-Maria Popescu, Alex Armanasu, Oren Etzioni, David Ko, and Alexander Yates, "Modern natural language interfaces to databases: Composing statistical parsing with semantic tractability," in *Proceedings of the 20th International Conference on Computational Linguistics* (pp. 141-147), Geneva, Switzerland, 2004.

[67]   Luke McDowell, Oren Etzioni, and Alon Y. Halevy, "The specification of agent behavior by ordinary people: A case study," in *Proceedings of the Third International Semantic Web Conference* (pp. 182-197), Hiroshima, Japan, 2004.

[68]   Oren Etzioni, Michael Cafarella, Doug Downey, Ana-Maria Popescu, Tal Shaked, Stephen Soderland, Daniel S. Weld, and Alexander Yates, "Methods for domain-independent information extraction from the web: An experimental comparison," in *Proceedings of the Nineteenth National Conference on Artificial Intelligence* (pp. 391-398), San Jose, CA, 2004.

[69]   Oren Etzioni, Michael Cafarella, Doug Downey, Stanley Kok, Ana-Maria Popescu, Tal Shaked, Stephen Soderland, Daniel S. Weld, and Alexander Yates, "Web-scale information extraction in knowitall (preliminary results)," in *Proceedings of the Thirteenth International World Wide Web Conference* (pp. 100-110), New York, NY, 2004.

[70]   Luke McDowell, Oren Etzioni, Alon Y. Halevy, and Henry M. Levy, "Semantic email," in *Proceedings of the Thirteenth International World Wide Web Conference* (pp. 244-254), New York, NY, 2004.

[71]   Luke McDowell, Oren Etzioni, Steven D. Gribble, Alon Y. Halevy, Henry M. Levy, William Pentney, Deepak Verma, and Stani Vlasseva, "Mangrove: Enticing ordinary people onto the semantic web via instant gratification," in *Proceedings of the Second International Semantic Web Conference* (754-770), Sanibel Island, FL, 2003.

[72] Oren Etzioni, Alon Y. Halevy, Henry M. Levy, and Luke McDowell, "Semantic email: Adding lightweight data manipulation capabilities to the email habitat," in *Proceedings of the Sixth International Workshop on the Web and Databases* (pp. 13-18), San Diego, CA, 2003.

[73] Oren Etzioni, Rattapoom Tuchinda, Craig A. Knoblock, and Alexander Yates, "To buy or not to buy: Mining airfare data to minimize ticket purchase price," in *Proceedings of the Ninth ACM SIGKDD International Conference on Knowledge Discovery and Data Mining* (pp. 119-128), Washington, DC, 2003.

[74] Daniel S. Weld, Corin R. Anderson, Pedro Domingos, Oren Etzioni, Krzysztof Gajos, Tessa A. Lau, and Steve A. Wolfman, "Automatically Personalizing User Interfaces," in *Proceedings of the Eighteenth International Joint Conference on Artificial Intelligence* (pp. 1613-1619), Acapulco, Mexico, 2003.

[75] Cody C. T. Kwok, Oren Etzioni, and Daniel S. Weld, "Scaling question answering to the web," in *Proceedings of the Tenth International World Wide Web Conference* (pp. 150-161), Hong Kong, China, 2001. Reprinted in *ACM Transactions on Information Systems*, vol. 19:3 (pp. 242-262), 2001.

[76] Mike Perkowitz and Oren Etzioni, "Towards adaptive web sites: Conceptual framework and case study," *Artificial Intelligence*, vol. 118:1-2 (pp. 245-275), 2000.

[77] Atsushi Sugiura and Oren Etzioni, "Query routing for web search engines: architecture and experiments," in *Proceedings of the Ninth International World Wide Web Conference*, Amsterdam, Netherlands, 2000. Reprinted in *Computer Networks and ISDN Systems*, vol. 33:1-6 (pp. 417-429), 2000.

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[79] Mike Perkowitz and Oren Etzioni, "Adaptive web sites: Conceptual cluster mining," in *Proceedings of the Sixteenth International Joint Conference on Artificial Intelligence* (pp. 264-269), Stockholm, Sweden, 1999.

[80] Mike Perkowitz and Oren Etzioni, "Towards adaptive web sites: Conceptual framework and case study," in *Proceedings of the Eighth International World Wide Web Conference*, Toronto, Canada, 1999. Reprinted in *Computer Networks and ISDN Systems*, vol. 31:11-16 (pp. 1245-1258), 1999.

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[84] Amitai Etzioni and Oren Etzioni, "Communities: Virtual vs. Real," *Science*, vol. 277:5324 (pp. 295), 1997.

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[86] Mike Perkowitz, Robert B. Doorenbos, Oren Etzioni, and Daniel S. Weld, "Learning to understand information on the Internet: An example-based approach," *Journal of Intelligent Information Systems*, vol. 8:2 (pp.133-153), 1997.

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[90] Oren Etzioni, Keith Golden, and Daniel S. Weld, "Sound and efficient closed-world reasoning for planning," *Artificial Intelligence*, vol. 89:1-2 (pp. 113-148), 1997.

[91] Oren Etzioni, "Moving up the information food chain: Deploying Softbots on the World Wide Web," in *Proceedings of the Proceedings of the Thirteenth National Conference on Artificial Intelligence* (pp. 1322-1326), Portland, OR, 1996.

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[93] Neal Lesh and Oren Etzioni, "Scaling up goal recognition," in *Proceedings of the Fifth International Conference on Principles of Knowledge Representation and Reasoning* (pp. 178-189), Cambridge, MA, 1996.

[94] Erik Selberg and Oren Etzioni, "Multi-service search and comparison using the metacrawler," *Proceedings of the Fourth International World Wide Web Conference* (pp. 195-208), Boston, MA, 1995.

[95] Neal Lesh and Oren Etzioni, "A sound and fast goal recognizer," in *Proceedings of the Fourteenth International Joint Conference on Artificial Intelligence* (pp. 1704-1710), San Francisco, CA, 1995.

[96] Mike Perkowitz and Oren Etzioni, "Category translation: Learning to understand information on the Internet," in *Proceedings of the Fourteenth International Joint Conference on Artificial Intelligence* (pp. 930-936), Montreal, Canada, 1995.

[97] Oren Etzioni, Henry M. Levy, Richard Segal, and Chandramohan A. Thekkath, "The softbot approach to OS interfaces," *IEEE Software*, vol. 12:4 (pp. 42-51), 1995.

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[100] Richard Segal and Oren Etzioni, "Learning decision lists using homogeneous rules," in *Proceedings of the Twelfth National Conference on Artificial Intelligence* (pp. 619-625), Menlo Park, CA, 1994.

[101] Oren Etzioni and Daniel S. Weld, "A softbot-based interface to the Internet," *Communications of the ACM*, vol. 37:7 (pp. 72-76), 1994.

[102]   Oren Etzioni, Keith Golden, and Daniel S. Weld, "Tractable closed-world reasoning with updates," in *Proceedings of the Fourth International Conference on Principles of Knowledge Representation and Reasoning* (pp. 178-189), Bonn, Germany, 1994.

[103]   Patricia Riddle, Richard Segal, and Oren Etzioni, "Representation design and brute-force induction in a Boeing manufacturing domain," *Applied Artificial Intelligence*, vol. 8:1 (pp. 125-147), 1994.

[104]   Oren Etzioni and Ruth Etzioni, "Statistical methods for analyzing speedup learning experiments," *Machine Learning*, vol. 14:3 (pp. 333-347), 1994.

[105]   Oren Etzioni, "Acquiring search-control knowledge via static analysis," *Artificial Intelligence*, vol. 62:2 (pp. 255-302), 1993.

[106]   Oren Etzioni, "A structural theory of explanation-based learning," *Artificial Intelligence*, vol. 60:1 (pp. 93-140), 1993.

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[108]   Oren Etzioni and Steven Minton, "Why EBL produces overly-specific knowledge: A critique of the PRODIGY approaches," in *Proceedings of the Ninth International Conference on Machine Learning* (pp. 137-143), Aberdeen, Scotland, 1992.

[109]   M. Alicia Pérez and Oren Etzioni, "DYNAMIC: a new role for training problems in EBL," in *Proceedings of the Ninth International Conference on Machine Learning* (pp. 367-372), Aberdeen, Scotland, 1992. An expanded version available as technical report CMU-CS-92-124.

[110]   Oren Etzioni, Steve Hanks, Daniel S. Weld, Denise Draper, Neal Lesh, and Mike Williamson, "An approach to planning with incomplete information," in *Proceedings of the Third International Conference on Principles of Knowledge Representation and Reasoning* (pp. 115-125), San Francisco, CA, 1992.

[111]   Oren Etzioni, "Embedding decision-analytic control in a learning architecture," *Artificial Intelligence*, vol. 49:1-3 (pp. 129-160), 1991.

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[113]   Craig Knoblock, Steve Minton, and Oren Etzioni, "Integrating abstraction and explanation-based learning in PRODIGY," in *Proceedings of the Ninth National Conference on Artificial Intelligence* (pp. 541-546), Anaheim, CA, 1991.

[114]   Prasad Chalasani, Oren Etzioni, and John Mount, "Integrating efficient model-learning and problem-solving algorithms in permutation environments," in *Proceedings of the Second International Conference on Principles of Knowledge Representation and Reasoning* (pp. 89-98), Cambridge, MA, 1991.

[115]   Oren Etzioni, "Why PRODIGY/EBL works," in *Proceedings of the Eighth National Conference on Artificial Intelligence* (pp. 916-922), Boston, MA, 1990.

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Referred Publications

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[2] Peter Clark, Isaac Cowhey, Oren Etzioni, Tushar Khot, Ashish Sabharwal, Carissa Schoenick and Oyvind Tafjord. "Think you have Solved Question Answering? Try ARC, the AI2 Reasoning Challenge." (2018).

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[4] Carissa Schoenick, Peter Clark, Oyvind Tafjord, Peter D. Turney and Oren Etzioni. "Moving Beyond the Turing Test with the Allen AI Science Challenge." *Commun. ACM* 60 (2017): 60-64.

[5] Amitai Etzioni and Oren Etzioni. "Designing AI systems that obey our laws and values." *Commun. ACM* 59 (2016): 29-31.

[6] Peter Clark and Oren Etzioni. "My Computer Is an Honor Student - but How Intelligent Is It? Standardized Tests as a Measure of AI." *AI Magazine* 37 (2016): 5-12.

[7] Thomas Lin, Mausam, and Oren Etzioni, "Commonsense from the Web: Relation Properties," in *Proceedings of the AAAI Fall Symposium on Commonsense Knowledge*, Arlington, VA, 2010.

[8] Janara Christensen, Mausam, Stephen Soderland, and Oren Etzioni, "Semantic Role Labeling for Open Information Extraction," in *Proceedings of the NAACL 2010 Workshop on Formalisms and Methodology for Learning by Reading*, Los Angeles, CA, 2010.

[9] Hoifung Poon, Janara Christensen, Pedro Domingos, Oren Etzioni, Raphael Hoffmann, Chloe Kiddon, Thomas Lin, Xiao Ling, Mausam, Alan Ritter, Stefan Schoenmackers, Stephen Soderland, Daniel S. Weld, Fei Wu, and Congle Zhang, "Machine Reading at the University of Washington," in *Proceedings of the NAACL 2010 Workshop on Formalisms and Methodology for Learning by Reading*, Los Angeles, CA, 2010.

[10] Alan Ritter, Stephen Soderland, and Oren Etzioni, "What Is This, Anyway: Automatic Hypernym Discovery," in *Proceedings of the AAAI Spring Symposium on Learning by Reading and Learning to Read*, Stanford, CA, 2009.

[11] Alexander Yates and Oren Etzioni, "Unsupervised Methods for Determining Object and Relation Synonyms on the Web," *Journal of Artificial Intelligence Research*, vol. 34: 255-296, 2009.

[12] Oren Etzioni, Michele Banko, Stephen Soderland, and Daniel S. Weld, "Open Information Extraction from the Web," *Communications of the ACM*, vol. 51(12): 68-74, 2008.

[13] Oren Etzioni, Michele Banko, and Michael J. Cafarella, "Machine Reading," in *Proceedings of the AAAI Symposium on Machine Reading*, Stanford, CA, 2007.

[14] Ronen Feldman, Binyamin Rosenfeld, Stephen Soderland, and Oren Etzioni, "Self-supervised Relation Extraction from the Web," in *Proceedings of the 16th International Symposium Foundations of Intelligent Systems* (pp. 755-764), Bari, Italy, 2006.

[15] Stephen Soderland, Oren Etzioni, Tal Shaked, and Daniel S. Weld, "The use of web-based statistics to validate information extraction," in *Proceedings of the AAAI Workshop on Adaptive Text Extraction and Mining*, San Jose, CA, 2004. Proceedings are available online at http://www.ai.sri.com/~muslea/AcceptedPapers.html.

[16] Luke McDowell, Oren Etzioni, Alon Y. Halevy, "Specifying semantic email processes," in *Proceedings of the WWW2004 Workshop on Application Design, Development and Implementation Issues in the Semantic Web*, New York, NY, 2004. Proceedings are available online at http://sunsite.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-105/.

[17] Alon Y. Halevy, Oren Etzioni, AnHai Doan, Zachary G. Ives, Jayant Madhavan, Luke McDowell, and Igor Tatarinov, "Crossing the structure chasm," in *Proceedings of the First Biennial Conference on Innovative Data Systems Research*, Asilomar, CA., 2003. Proceedings are available online at http://www-db.cs.wisc.edu/cidr2003/program/program.html.

[18] Alexander Yates, Oren Etzioni, and Daniel S. Weld, "A reliable natural language interfaces to household appliances," in *Proceedings of the 2003 Conference on Intelligent User Interfaces* (pp. 189-196), Miami, FL, 2003.

[19] Ana-Maria Popescu, Oren Etzioni, and Henry A. Kautz, "Towards a theory of natural language interfaces to databases," in *Proceedings of the 2003 Conference on Intelligent User Interfaces* (pp. 149-157), Miami, FL, 2003.

[20] Mike Perkowitz and Oren Etzioni, "Adaptive Web sites," *Communications of the ACM*, vol. 43:8 (pp. 152-158), 2000.

[21] Tessa A. Lau, Oren Etzioni, and Daniel S. Weld, "Privacy interfaces for information management," *Communications of the ACM*, vol. 42:10 (pp. 88-94), 1999.

[22] Amitai Etzioni and Oren Etzioni, "Face-to-face and computer-mediated communities, a comparative analysis," *The Information Society*, Vol. 15:4 (pp. 241-248), 1999.

[23] David Hsu, Oren Etzioni, and Stephen Soderland, "A redundant covering algorithm applied to text categorization," in *Working Notes of the 1998 AAAI Workshop on Learning for Text Categorization* (pp. 18-25), Madison, WI, 1998.

[24] Erik Selberg and Oren Etzioni, "The metacrawler architecture for resource aggregation on the web," *IEEE Expert*, vol. 12:1 (pp. 8-14), 1997.

[25] Oren Etzioni, "Moving up the information food chain: Deploying Softbots on the World Wide Web," *AI Magazine* Vol. 18:2 (pp. 11-18), 1997.

[26] Oren Etzioni, "The World Wide Web: quagmire or gold mine?" *Communications of the ACM*, vol. 37:11 (pp. 65-68), 1996.

[27] Oren Etzioni and Daniel Weld, "Intelligent agents on the Internet: Fact, fiction, and forecast," *IEEE Expert*, vol. 10:4 (pp. 44-49), 1995.

[28] Oren Etzioni, "Intelligence without robots: A reply to Brooks," *AI Magazine*, 14:4 (pp. 7-13), 1993.

[29] Oren Etzioni and Neal Lesh, "Planning with incomplete information in the UNIX domain," in *Working Notes of the AAAI Spring Symposium: Foundations of Automatic Planning: The Classical Approach and Beyond* (pp. 24-28), Stanford, CA, 1993.

[30] Oren Etzioni and Richard Segal, "Softbots as testbeds for machine learning," in *Working Notes of the AAAI Spring Symposium on Knowledge Assimilation* (pp. 43-50), Stanford, CA, 1992.

[31] Patricia Riddle, Oren Etzioni, Carl Pearson, and Richard Segal, "Process improvement through automated feedback (preliminary report)," in *Proceedings of the Machine Learning Workshop on*

Integrated Learning in Real-World Domains, Aberdeen, Scotland, 1992. Also in *Proceedings of the Canadian Machine Learning Workshop*, Vancouver, Canada, 1992.

[32]   Jaime Carbonell, Oren Etzioni, Yolanda Gil, Robert Joseph, Craig Knoblock, Steve Minton, and Manuela Veloso, "PRODIGY: An integrated architecture for planning and learning," in *Working Notes of the AAAI Spring Symposium on Integrated Intelligent Architectures* (pp. 38-43), Stanford, CA, 1991.

[33]   Steven Minton, Craig A. Knoblock, Oren Etzioni, Jaime G. Carbonell, Manuela M. Veloso, "Evaluating the integration of EBL and abstraction in PRODIGY," in *Workshop on Empirical Machine Learning*, 1991.

[34]   Steven Minton, Jaime G. Carbonell, Oren Etzioni, Craig A. Knoblock, and Daniel R. Kuokka, "Acquiring effective search control rules: Explanation-based learning in the PRODIGY system," in *Proceedings of the Fourth International Workshop on Machine Learning*, Irvine, CA, 1987.

Unreferred Publications

[1]   Peter Clark, Oren Etzioni, Daniel Khashabi, Tushar Khot, Bhavana Dalvi Mishra, Kyle Richardson, Ashish Sabharwal, Carissa Schoenick, Oyvind Tafjord, Niket Tandon, Sumithra Bhakthavatsalam, Dirk Groeneveld. "From 'F' to 'A' on the N.Y. Regents Science Exams: An Overview of the Aristo Project." (2019).

[2]   Lucy Lu Wang, Gabriel Stanovsky, Luca Weihs, Oren Etzioni. "Gender trends in computer science authorship." *arXiv* (2019).

[3]   Roy Schwartz, Jesse Dodge, Noah A. Smith, Oren Etzioni. "Green AI." *arXiv* (2019).

[4]   Sergey Feldman, Waleed Ammar, Kyle Lo, Elly Trepman, Madeleine van Zuylen, Oren Etzioni. "Quantifying Sex Bias in Clinical Studies at Scale With Automated Data Extraction." *JAMA* (2019).

[5]   Oren Etzioni. "Technical perspective: Breaking the mold of machine learning." *Commun. ACM 61* (2018): 102

Grants and Contracts

2019: *RAISE: C-Accel Pilot - Track A1: Simultaneous Knowledge Network Programming and Extraction.* NSF, $1,000,000 (Co-PI, joint with Prof. Michael Cafarella, The University of Michigan)

2012 – 2017: *Composing Information Extraction, Semantic Parsing and Tractable Inference for Deep NLP.* DARPA, $4,581,954. (Lead PI, joint with Profs. Domingos, Weld, and Zettlemoyer)

2013 – 2015: *Open Information Extraction for Situational Awareness..,* ARO, $1,500,000.

2012-2014: *Halo Project,* Vulcan $915,000 (Research Contract).

2009-2014: *Machine Reading*, AFRL, $1,999,970 (BBN subcontract).

2009-2011: *Reading the Web: Utilizing Markov Logic in Open Information Extraction*, NSF, $32,000 REU supplement.

2008-2011: *Reading the Web: Utilizing Markov Logic in Open Information Extraction*, NSF, $899,716. (lead PI, join with Prof. Domingos)

2008-2010: *Open Information Extraction*, ONR, $352,946.

2008-2009: *Unsupervised Non-stop Extraction of Information from the World Wide Web*, NSF, $12,000 REU supplement.

2006-2009: *Unsupervised Non-stop Extraction of Information from the World Wide Web*, NSF, $480,000.

2005-2007: *Semantic Tractability on the World Wide Web*, ONR, $376,547.

2004-2005: *An Agent-based Interface to Terrestrial Ecological Forecasting*, NASA, $149,998 (NASA Ames subcontract).

2004: *Beowulf Cluster Supercomputing for AI, Data Mining, and Database Research*, DOD/ONR, $134,689 (with UW's AI and DB groups).

2003-2007: *CALO Research*, DARPA, $1,307,685 (SRI subcontract).

2003-2007: *ITR: Semantically Tractable Questions: Theory and Implementation*, NSF, $395,000.

2002-2005: *Scaling Up Natural Language Interfaces*, ONR, $306,000.

2002 *SGER: Assisted Cognition: First Steps Towards Computer Aids for People with Alzheimer's Disease*, NSF, $100,000 (with Profs. Kautz and Fox).

1999-2002: *An Automated reference Librarian for the Web*, NSF, $599,000 + $40,000 UW matching funds (with Prof. Weld).

1997-2000: *Web Analysis Tools for Text Mining and Knowledge Discovery*, USA-Israel Binational Science Foundation, approximately $100,000 (with Profs. Amir, Feldman, and Hirsh).

1996-1997: *Intelligent Oceanographic Agents*, ONR, $106,562 (with UW APL).

1996-1998: *Providing Softbot Technology for the Tactical Picture Agent*, ONR, $199,000.

1995-1998: *Softbots: Customizable Agents for the NII*, ARPA, $1,376,118 (with Profs. Hanks and Weld).

1995: *Softbots*, Washington Technology Center, $10,000 + $2,500 matching funds from Ark Interface Inc.

1994: *Planners for Software Agents*, Apple Computer, $39,736 NYI matching funds (with Prof. Weld).

1994-1996: *Building a Software Robot for UNIX*, ONR, $296,881 supplement.

1993-1998: Young Investigator Award, *Softbots as testbeds for AI*, NSF, up to $312,500 (including NSF matching funds).

1993-1996: AASERT, *Linking the UNIX Softbot to the Calendar Apprentice*, ONR, $136,386.

1993-1994: *Personal Communication Assistant*, Northern Telecom, $95,000.

1993-1994: *Building an Intelligent UNIX Assistant*, University of Washington Royalty Research Fund, $21,400.

1993: *Building a Software Robot for UNIX*, ONR, $70,000 supplement.

1992: *Building a Software Robot for UNIX*, ONR, $54,830.

1992-1994: Research Initiation Award, *Explanation-Based Learning: Finding Better Explanations via Partial Evaluation*, NSF, $60,000.

1992-1993: *Process Improvement through Automated Feedback*, Boeing Computer Services, $48,861.

1991-1992: *Speedup Learning for AI Planners*, University of Washington Graduate School Research Fund, $9,859.

Gifts

2013: Google, gift in support of faculty research, $70,000.
2010: Google, gift in support of faculty research, $60,000.
2009: Washington Research Foundation, gift in support of endowed professorship, $100,000.
2008: Toyota InfoTechnology Center USA, Inc., gift in support of faculty research, $90,000.
2008: Google, gift in support of faculty research, $60,000.
2008: Madrona Venture Group, gift in support of the Turing Center, $10,000.
2007: Washington Research Foundation, gift in support of the Turing Center, $50,000.
2007: Google, gift in support of faculty research, $50,000.
2006: Google, gift in support of faculty research, $100,000.
2005: Utilika Foundation, gift to create the Turing Center, $2,000,000.
2004: Google, gift in support of faculty research, $100,000.
2004: Nippon Telegraph and Telephone Corporation, gift in support of faculty research, $65,000.
2004: Intel Research, gift in support of faculty research, $42,000.
2003: Washington Research Foundation, gift in support of faculty research, $30,000.
2003: Google, gift in support of faculty research, $100,000.
1998: NEC, gift in support of faculty research, $50,000.
1995: US West, gift in support of faculty research, $7,500.
1995: Rockwell International Corporation, gift in support of faculty research, $6,000.

Post-Doctoral Fellows

1. Niranjan Balasubramanian   (2010 Ph.D. University of Massachusetts at Amherst)

2. Mausam (2007 Ph.D. University of Washington)

3. Stephen Soderland (1997 Ph.D. University of Massachusetts at Amherst).

4. Bob Doorenbos (1995 Ph.D. Carnegie Mellon University)

Ph.D. Students Advised

1. Dr. Anthony Fader (Research Scientist, AI2, 2014). Co-advisor: Luke Zettlemoyer.

2. Dr. Alan Ritter (CMU Post-Doc, Asst. Prof. Ohio State University, 2013). Co-advisor: Mausam.

3. Dr. Thomas Lin (Microsoft, 2012). Co-Advisor: Mausam.

4. Dr. Stefan Schoenmackers (Decide.com, 2010). Co-Advisor: Dan Weld

5. Dr. Michael J. Cafarella (University of Michigan, 2009). Mike's dissertation, *Extracting and Managing Structured Web Data*. Co-Advisor: Dan Suciu.

6. Dr. Michele Banko (Evri, 2009). Michele's dissertation, *Open Information Extraction for the Web*.

7. Dr. Doug Downey (Northwestern University, 2008). Doug's dissertation, *Redundancy in Web-scale Information Extraction: Probabilistic Model and Experimental Results*.

8. Dr. Alex Yates (Temple University, 2007). Alex's dissertation, *Information Extraction from the Web: Techniques and Applications*, investigated the problem of unsupervised synonym resolution on the Web.

9. Dr. Ana-Maria Popescu (Yahoo, 2007). Ana-Maria's dissertation, *Information Extraction from Unstructured Web Text*, investigated how to extract high-quality information from Web text. Her most impressive demonstration was the Opine system, which extracted product attributes, and associated opinions, from reviews found on-line.

10. Dr. Luke McDowell (US Naval Academy, 2004). Luke's dissertation, *Bringing Semantics to the Masses: Theory and Applications for Semantic Web and Semantic Email Systems*, investigated how to make the Semantic Web a reality and how to generalize the vision to encompass email as well. Co-Advisor: Alon Halevy.

11. Dr. Mike Perkowitz (Amazon, 2000). Mike's dissertation, *Adaptive Web Sites: Cluster Mining and Conceptual Clustering for Index Page Synthesis*, investigated web sites that automatically reconfigure their layout and presentation by analyzing user access patterns recorded in their server logs.

12. Dr. Oren Zamir (Google, 1999). Oren's dissertation, *Clustering Web Documents: A Phrase-Based Method for Grouping Search Engine Results*, investigated the use of a novel and fast clustering algorithm to group the results of Web search engines into easily-browsed clusters. The most distinctive aspect of the algorithm was its treatment of documents as strings of words, represented by a suffix tree, in contrast with the standard vector-based representation.

13. Dr. Erik Selberg (Microsoft, 1999). Erik's dissertation, *Towards Comprehensive Web Search*, explored meta-search as embodied in MetaCrawler. The dissertation was the first to show (back in WWW4, 1995) that the fraction of the Web covered by individual search engines such as Alta Vista and Lycos was very limited, demonstrating the need for meta-search engines.

14. Dr. Keith Golden (NASA Ames, 1997). Keith's dissertation, *Planning and Knowledge Representation for Softbots*, investigated novel planning and knowledge representation techniques to support softbots. Primary advisor: Dan Weld.

15. Dr. Neal Lesh (MERL, 1997). Neal's dissertation, *Scalable and Adaptive Goal Recognition*, focused on automating the construction of plan libraries adapting techniques from planning and concept learning. His objective was to scale up goal recognition to domains containing millions of plans and goals.

16. Dr. Richard Segal (IBM Watson Research Center, 1996). Richard's dissertation, *Machine Learning as Massive Search*, focused on data mining using massive search: our BRUTE data mining software can analyze over 100,000 hypotheses per second, when run on a SPARC-10.

Masters Students Advised

1. Tessa Lau (IBM Almaden Research Center, 1997). *Privacy in a Collaborative Web Browsing Environment*.

2. Marc Langheinrich (ETH Zurich, Switzerland, 1997). *A domain independent architecture for efficient information retrieval on the World Wide Web*.

3. Jonathan Shakes (Amazon, 1996). *Dynamic Reference Sifting: a Case Study in the Homepage Domain*.

4. Terrance Goan (Stottler Henke Associates, 1994). *Learning About Software Errors*.

Undergraduate Students Advised

1. Daniel Crowell
2. Catherine Ono
3. Christopher Lim, 2009 (UW CSE Master's Student)
4. Michael Skinner, 2008 (Google)
5. Kobi Reiter, 2006 (Google)
6. Bao Nguyen, 2005 (Microsoft)
7. Michael Lindmark, 2005 (Amazon)
8. Tessa MacDuff, 2004 (Google)
9. Jeff Lin, 2003 (Microsoft)
10. Gary Lau, 1999 (Go2Net)
11. Zhenya Sigal, 1997 (Microsoft)
12. Christen Boyd, 1997 (Netbot)
13. Darren Schack, 1996 (Real Networks)
14. Adam Loving, 1996
15. Nick Hart, 1996 (Real Networks)
16. Nels Benson, 1995 (Japan)
17. Dymitr Mozdyniewicz, 1995 (Quark)
18. Guido Hunt, 1994
19. Greg Fichtenholtz, 1994 (Hewlett-Packard, Stanford)
20. William Alford, 1994 (PhD program, University of Wisconsin)
21. Robert Spiger, 1993 (Lockheed, AI research center)
22. Bruce Lesourd, 1993
23. Julie Roomy, 1993 (Hewlett-Packard, OGI)
24. Stephen Soderland, 1992 (PhD program, Umass Amherst, Postdoc UW)

Courses Taught

CSE 142: Computer Programming I.
CSE 326: Data Structures.
CSE 454: Advanced Internet and Web Services.
CSE 473: Introduction to Artificial Intelligence.
CSE 546: Data Mining.
CSE 573: Artificial Intelligence I.
CSE 574: Autonomous Agents.
CSE 574: Machine Learning.
CSE 574: Intelligent User Interfaces.
CSE 590: Graduate seminar on AI.

Technology Transfer

Co-Founder and CTO of Decide.com July 2010 – August 2013 (acquired by eBay)

Founder of Farecast, Inc. October 2004 – 2008 (acquired by Microsoft)

Venture Partner at Madrona Venture Group, March 2000 –

Co-Founder and Chief Scientist, Netbot, Inc., May 1996 – November 1997

Patents Awarded

1. U.S. Patent 8,209,164: Use of lexical translations for facilitating searches
2. U.S. Patent 7,877,343: Open information extraction from the Web
3. U.S. Patent 7,797,187: System and method of protecting prices
4. U.S. Patent 7,010,494: Performing predictive pricing based on historical data
5. U.S. Patent 6,701,310: Information search device and information search method using topic-centric query routing
6. U.S. Patent 6,085,186: Method and system using information written in a wrapper description language to execute query on a network
7. U.S. Patent 20,140,032,209: Open Information Extraction